

**Polymeric Titanium Oxide Nano-Strands
Photocatalytic Nano Coating Material
For
Building Protection & Environmental Applications**

By
Mohan K. Dongare
Scientist, National Chemical Laboratory, Pune
Director: EnviPure Innovations
(16 Symphony-C, Range Hills Road, Pune-411020)
mohanenvipure@gmail.com
Mob: 9422339251

“Outline of Presentation”

Background

Air Pollution / Human Health

Depolluting Technologies

Photocatalytic Oxidation for Air Purification

International Scenario

Our Technology / Polymeric Nano Titania (TitanCat)

Our results

Future Plans



“Fostering Partnership For Sustainable Habitat”

The global community finds itself at a critical juncture today. We all recognize that succeeding in the attempts to mitigate climate change, control GHG emissions and combat various environmental issues is not down to one person. It's about being resilient, with collaboration being the key ingredient that makes it all possible.

The 10th GRIHA Summit with the theme “fostering Partnership for Sustainable Habitat” shall serve as a platform to deliberate on inter dependence between organizations, systemic sustainability management, and feedback loops for better resource efficiency.



Existing Condition Of Health



Times Of India 07/12/2018

Air pollution causes 1 in every 8 deaths in India: **ICMR** report 'Deadlier Than Smoking In Causing Illness'

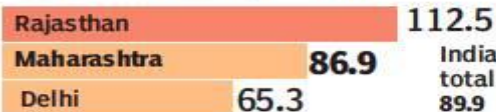
Sushmi.Dey@timesgroup.com

- **50%** pollution deaths in under-70 age group
- In **2017**, air pollution accounted for **12.4 lakh deaths in India**, which included 6.7 lakh deaths due to outdoor particulate matter air pollution and 4.8 lakh deaths due to household air pollution
- In 2017, India witnessed **1.10 lakh premature deaths of children due to air pollution, highest in the world** in the category of kids under five years of age.

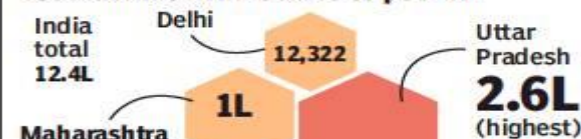
HOUSEHOLD POLLUTION CAUSE FOR WORRY

DEATHS DUE TO AIR POLLUTION 2017: WHAT REPORT SAYS

Death rate per 1L population attributable to air pollution



Total deaths attributable to poor air



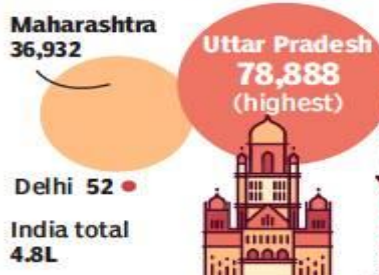
% of deaths attributable to air pollution in those aged below 70



Deaths attributable to ambient particulate matter pollution



Deaths attributable to household air pollution



“In Maharashtra, Mumbai and Pune are exposed to high vehicular pollution and Chandrapur to industrial pollution. Biomass is still used for cooking. Items such as mosquito coils, incense, dhoop and floor cleaners have dangerous emission levels

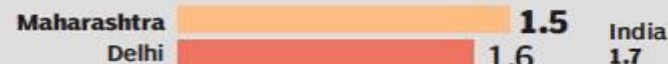
Dr Sundeep Salvi | CHEST RESEARCH FOUNDATION, PUNE

In many districts, use of solid fuel is high. This way you end up exposing people to both ambient and household pollution—**Kalpna Balakrishnan** | LEAD AUTHOR OF STUDY


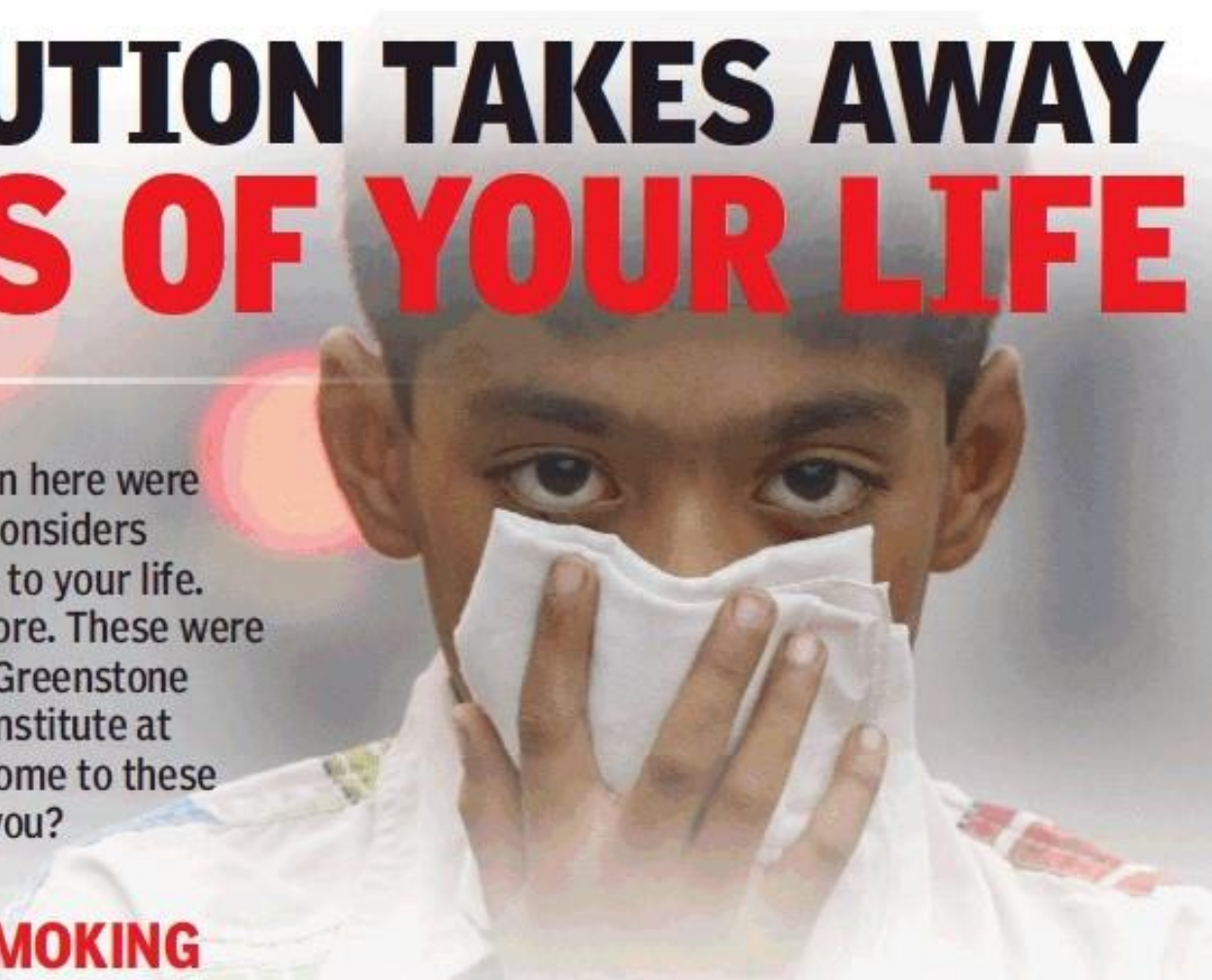
Current life expectancy at birth in 2017 (in years)



Increase in life expectancy if air pollution reduced to safe limits (in years)



WHY POLLUTION TAKES AWAY 10 YEARS OF YOUR LIFE



If you happen to live in Delhi, and pollution here were to come down drastically to levels WHO considers safe, then you could hope to add 10 years to your life. Overall, Indians could live for 4.3 years more. These were the findings of a global study by Michael Greenstone and Claire Qing Fan of the Energy Policy Institute at the University of Chicago. How did they come to these conclusions? And what does it mean for you?

POLLUTION WORSE THAN SMOKING



Pollution may up autism risk in kids

Study Says PM2.5 Makes Them 78% More Prone To ASD

Beijing:

Exposure to sources of outdoor pollution such as vehicle exhausts and industrial emissions can increase a child's **risk of developing autism spectrum disorder (ASD) by up to 78%**, a study has warned. The research followed children in Shanghai from birth to three years to understand the effect of exposure to fine particles (PM2.5).

The study included 124 ASD children and 1,240 healthy children in stages over a nine-year period, examining the association between air pollution and ASD.

FIGHT FOR CLEAN AIR: In India and China, outdoor pollutants contribute to a high burden of disease and premature deaths



Air pollution can affect brain too, hit verbal and math skills: Study

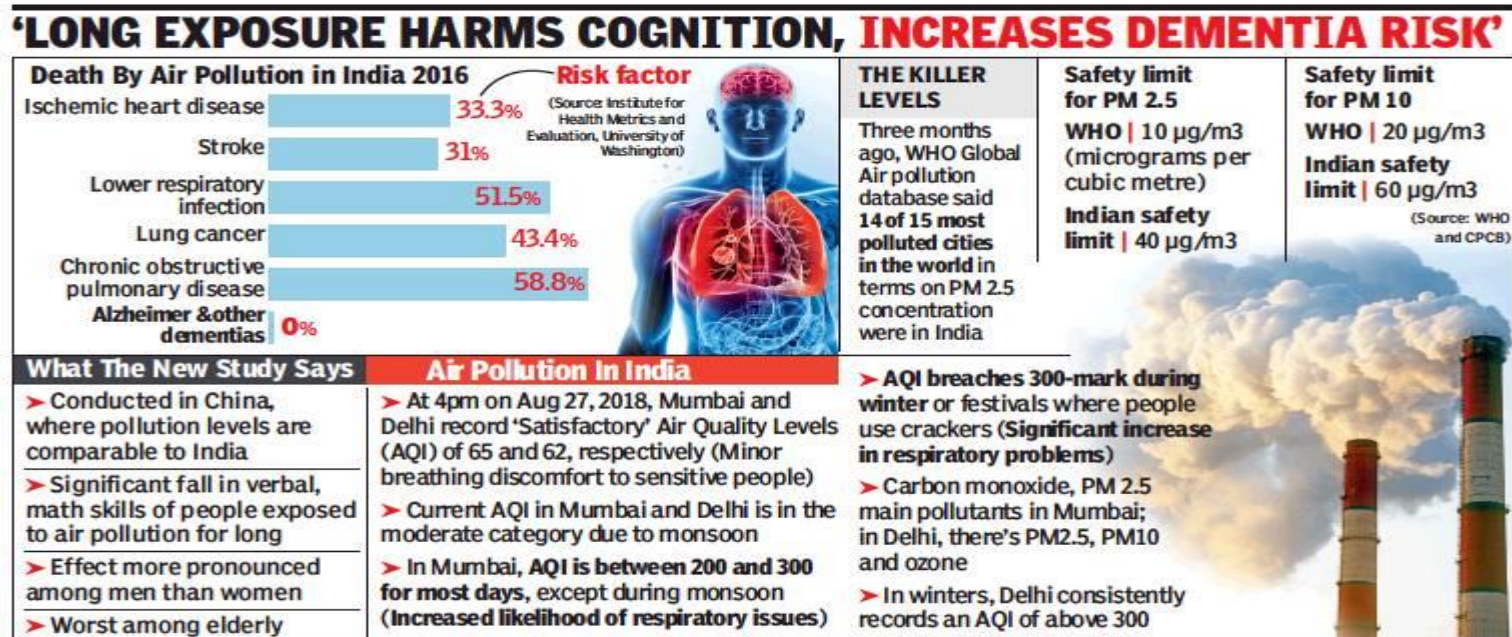
MALATHY IYER & VINAMRATA BORWANKAR TNN

Mumbai:

Air pollution not only harms the heart and lungs, a new study indicates it affects the brain so much that people, especially the elderly, could struggle for words or to complete simple math.

Long-term exposure to air pollution severely affects cognitive skills, according to the joint study by **Yale and Peking Universities** and published in the reputed **Proceedings of National Academy of Science (PNAS)** journal.

“The PNAS study found significant reduction in verbal and math skills of people exposed to air pollution over a long duration,” said a release sent by the Washington based International Food Policy Research Institute that conducted the study along with Yale and Peking universities. “The effect was more pronounced among men than women—and worst among the elderly,” it added.



“Air Pollution”

- Clean air is considered to be the basic requirement for human health and well-being. However, air pollution continues to pose a significant threat to human health worldwide.
- **Most harmful air pollutants are pm2.5, NOx, VOC, CO, SOx.**
- The increased public concern about the environmental pollution.
- The Present development of effective pollution removal technologies.
- Catalytic converters for automobile.
- In-house air purifiers/air filters.
- **Limitations**



WHAT NEXT??

Photocatalytic Oxidation Of Pollutants



“Photocatalytic TiO₂”

Photocatalytic TiO₂ (PCO or photocatalytic oxidation – the light activated reversal of photosynthesis) is a 45 year old technology that has been the subject of **9,000+ patents & 34,000+ scientific articles**.

Widely studied for its potential to improve environmental remediation and infection control, there have been 30+ international conferences on the use of photocatalytic TiO₂ to treat air and water pollution. PCO products (self-cleaning glass, tile and aluminum cladding; smog reducing cement and paint; PCO air purifiers, etc.) generate nearly **\$2 billion of commercial activity a year – mostly in Europe and Asia**.

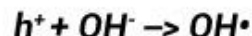


“Photo-Catalytic Oxidation (PCO) Process”

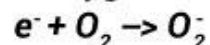
----- WORKING OF TiO_2 PHOTOCATALYTIC MATERIAL -----

Generation of electron-hole pairs: $\text{TiO}_2 + h\nu \rightarrow h^+ + e^-$

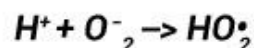
The H^+ reacts with OH^- dissociated from water to form the hydroxyl radical.



The e^- reacts with molecular oxygen to form the superoxide anion.



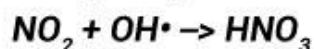
The superoxide anion further reacts with H^+ dissociated from water to produce HO_2^\bullet radicals.



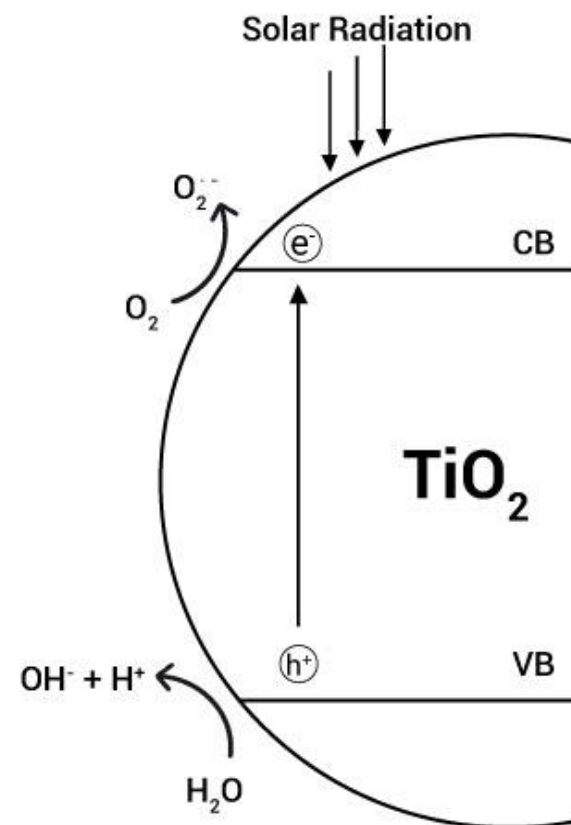
NO diffuses to the surface TiO_2 and is oxidized to NO_2 by HO_2^\bullet radicals.



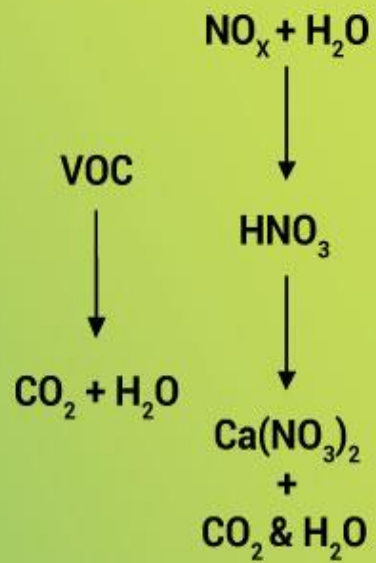
Finally, NO_2 reacts with hydroxyl radicals to form nitric acid.



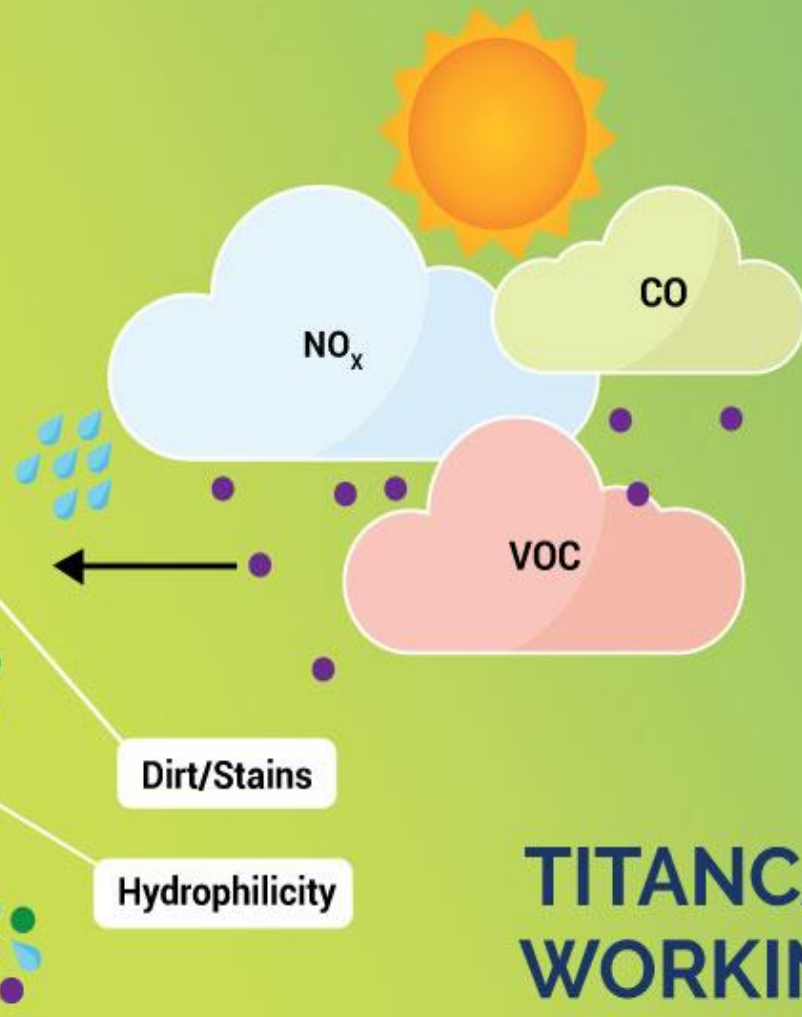
CB: Conduction Band | VB: Valance Band



TITANCAT



Plastered/Painted wall



TITANCAT WORKING



Contents lists available at ScienceDirect

Applied Catalysis B: Environmental

journal homepage: www.elsevier.com/locate/apcatb



Review

Solar photocatalysis: Materials, reactors, some commercial, and pre-industrialized applications. A comprehensive approach

Danilo Spasiano^a, Raffaele Marotta^{a,*}, Sixto Malato^b, Pilar Fernandez-Ibañez^b,
Ilaria Di Somma^c

^a Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, Università degli Studi di Napoli "Federico II",
P.le V. Tecchio, 80, 80125, Napoli, Italy

^b Plataforma Solar de Almería-CIEMAT, Carretera de Senés Km 4, 04200, Tabernas, Almería, Spain

^c Istituto di Ricerche sulla Combustione, Consiglio Nazionale delle Ricerche (CNR), P.le V. Tecchio, 80, 80125, Napoli, Italy

A B S T R A C T

In the future, solar energy, along with other renewable resources, could play a key role in mass production of fine chemicals. It could also potentially solve environmental problems, as demonstrated by recent developments in the use of solar energy, such as solar photocatalysis. The solar photocatalytic technology has been demonstrated to be effective for:

- Treating groundwater, drinking water, industrial wastewater, and air and soil pollution,
- Water disinfection, and
- Industrial production of fine chemicals.





Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman



Construction of a photocatalytic de-polluting field site in the Leopold II tunnel in Brussels



E. Boonen^{a, *}, V. Akylas^b, F. Barmpas^b, A. Boréave^c, L. Bottalico^d, M. Cazaunau^e, H. Chen^e, V. Daële^e, T. De Marco^d, J.F. Doussin^f, C. Gaimoz^f, M. Gallus^g, C. George^c, N. Grand^f, B. Grosselin^e, G.L. Guerrini^h, H. Herrmannⁱ, S. Ifang^g, J. Kleffmann^g, R. Kurtenbach^g, M. Maille^f, G. Manganelli^d, A. Mellouki^e, K. Miet^f, F. Mothesⁱ, N. Moussiopoulos^b, L. Poulainⁱ, R. Rabeⁱ, P. Zapf^f, A. Beeldens^a

^a Belgian Road Research Centre (BRRC), Woluwedal 42, 1200 Brussels, Belgium

^b Laboratory of Heat Transfer and Environmental Engineering (LHTEE), Aristotle University of Thessaloniki, Box 483, GR 54124 Thessaloniki, Greece

^c Université Lyon 1, CNRS, UMR5256, IRCELYON, Institut de Recherches sur la Catalyse et l'Environnement de Lyon, Villeurbanne, Lyon F 6962, France

^d CTG Italcementi Group, Via Stezzano 87, 24126 Bergamo, Italy

^e Institut de Combustion, Aérothermique, Réactivité et Environnement (ICARE), CNRS (UPR 3021)/OSUC, 1C Avenue de la Recherche Scientifique, Orléans, France

^f IISA, UMR CNRS 7583, Université Paris Est Créteil et Université Paris Diderot, Institut Pierre Simon Laplace, Créteil, France

^g Physikalische Chemie /FB C, Bergische Universität Wuppertal (BUW), Gaußstr. 20, 42119 Wuppertal, Germany

^h Italcementi Group, Via Stezzano 87, 24126 Bergamo, Italy

ⁱ Leibniz-Institut für Troposphärenforschung e.V. (TROPOS), Atmospheric Chemistry Dept., Permoserstraße 15, 04318 Leipzig, Germany

INTERNATIONAL SCENARIO



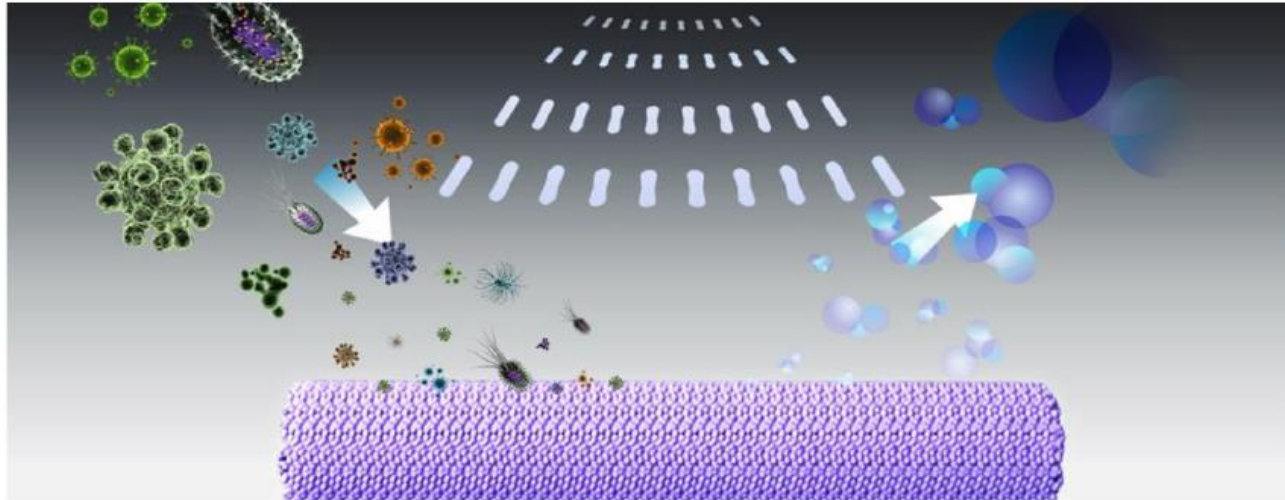
airocide

DEVELOPED BY **NASA**

Airocide

Photocatalytic Air Purification System





Technology

Airocide® Photocatalytic Air Purification System; developed to oxidize all airborne organic matter, even those too small to be filtered. Airocide's unique technology employs a reaction chamber packed with tiny silicone tubes encrusted with a highly reactive titanium dioxide catalyst. When energized by the system's 253.7 nanometer UVG lamps, water molecules are split and surface-bound hydroxyl radicals are formed. Any organic matter, no matter how small, that contacts these HO- radicals is instantly destroyed. Airocide is listed by the FDA as a Class II medical device and has been shown by independent Air Quality Labs to be free of any ozone emission. The process results in only trace amounts of pure water vapor and CO₂. Airocide oxidizes mold spores, mycotoxins, bacteria, viruses, VOCs (gasses) and Ozone on contact. Proven on the International Space Station and Space Shuttle flights, Airocide is simply the one that NASA developed. Airocide works.



International Status

CRISTAL **ACTIV**™

鯉 | KON
CORPORATION

pureti 

 **Italcementi**
Italcementi Group

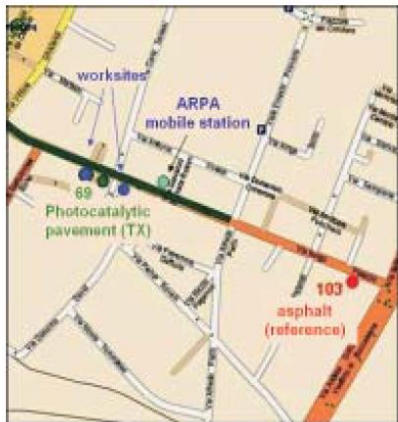
PHOTOCAT

"10th GRIHA SUMMIT"



Borgo Palazzo street – Bergamo, Italy

The project involved the requalification of about 500 m of Borgo Palazzo street in Bergamo, accounting for an active surface area of about 7,000 m² with grey paving stones for the road and red ones for the sidewalks.



Umberto Tunnel – Rome Italy



Combined lamp (UV + visible light)



Tunnel after renovation

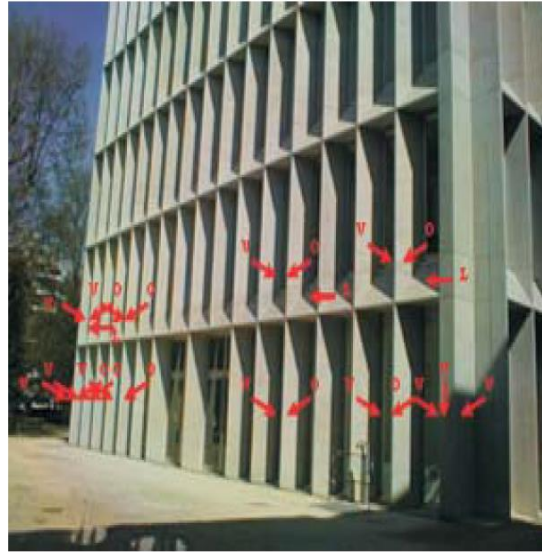


Dives in Misericordia Church – Rome



Hotel de Police – Bordeaux, France

La Cité de la Musique et des Beaux-Arts - Chambéry, France



**Air France Headquarters
Roissy Charles de Gaulle International Airport**





This NYC luxury building has the air-purifying power of 500 trees

By [Sangeeta Singh-Kurtz](#) May 7, 2018

Manhattan's trendy west SoHo neighborhood just got an eco-friendly new addition with [570 Broome](#). From the outside, the 25-story building looks like a regular luxury condo. But it's actually the first building in the US to boast a subtle but powerful enhancement that makes it good for the planet.

The facade is coated with a spray-on solution called Pureti. The treatment, which is water-based, provides 570 Broome with the purifying power of 500 trees—which is basically like taking 2,000 cars off the road for a year.

Pureti works by breaking down contaminants clogging Manhattan's air via a photocatalytic process that transforms polluting particles into oxidizing agents. They're then released into the atmosphere as harmless minerals. This process happens super fast—like millions-of-times-per-second fast—so that the surface is perpetually [self-cleaning](#), minimizing operational costs for the building.



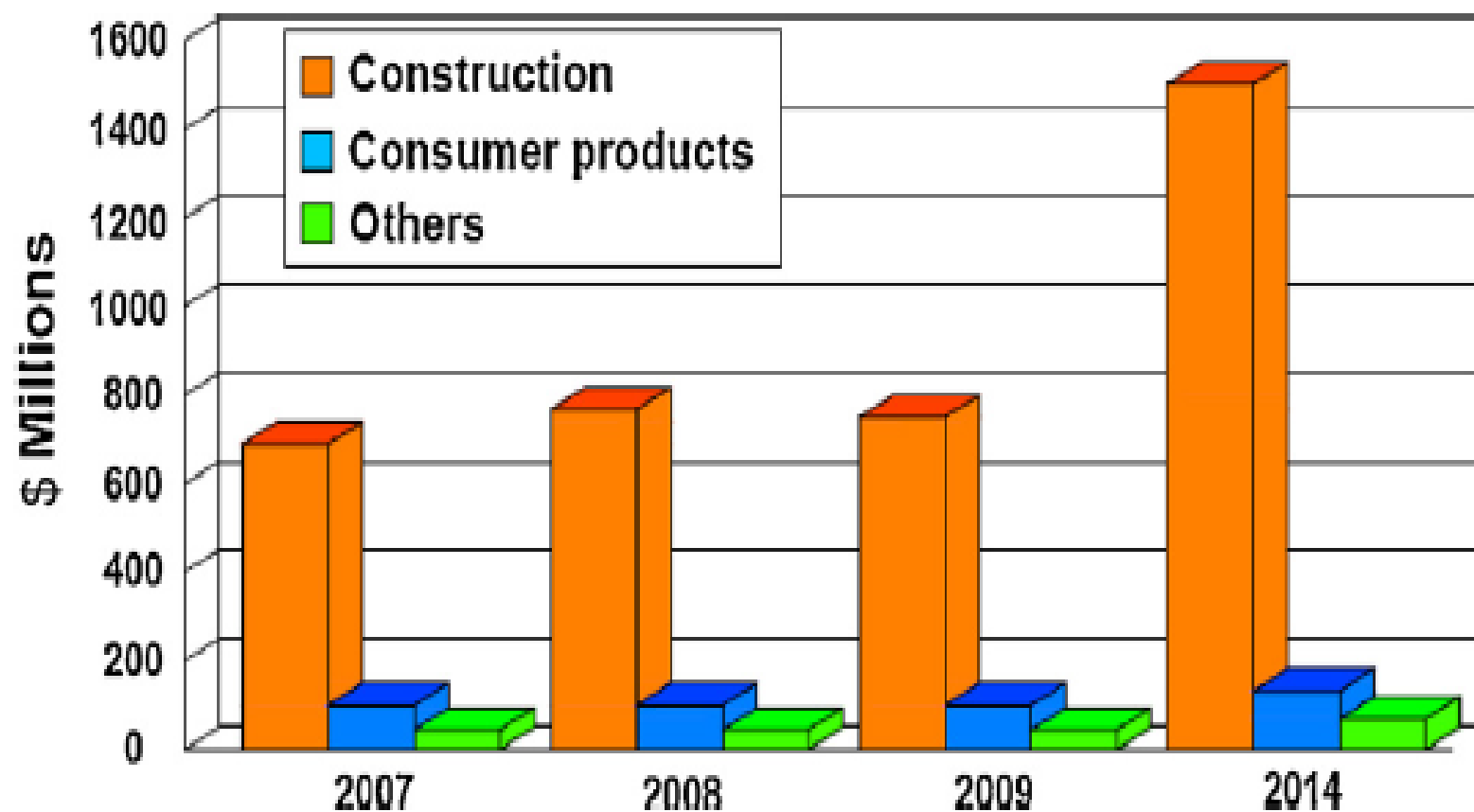


Fig. 1. Global market for photocatalyst products 2007–2014 (\$ millions).

“OUR TECHNOLOGY”



TITANCAT

Polymeric Titanium Oxide Nano-Strands with unusual properties

**Chemical composition : 99.71% water, 0.29% solid
Ti-Oxide : Water (Molar ratio) 1 : 1000**

Viscous material & Soluble in water.

Viscosity : 8000-12000 cps

Zeta potential : -30 to -80 mV

Stability : Stable and reusable.

Photocatalyst : Very active in solarlight.



Titanium Oxide Nano Strands



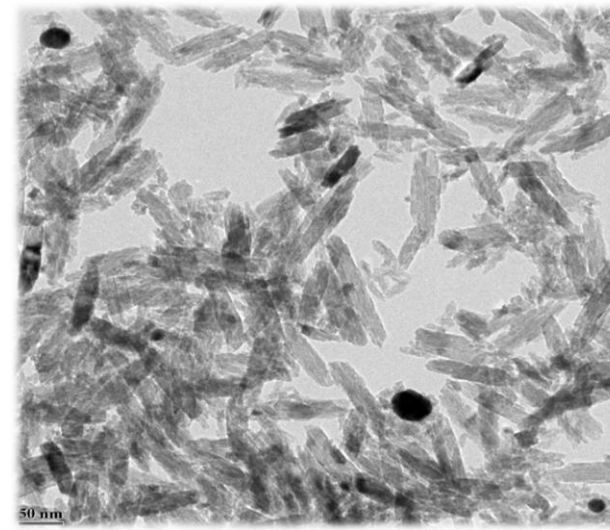
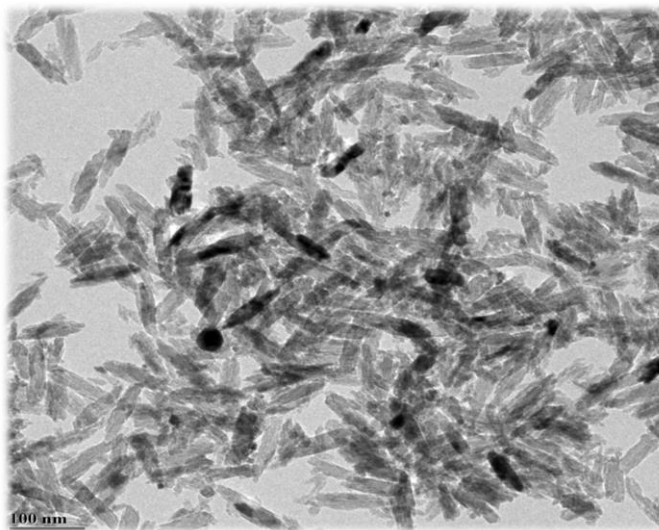
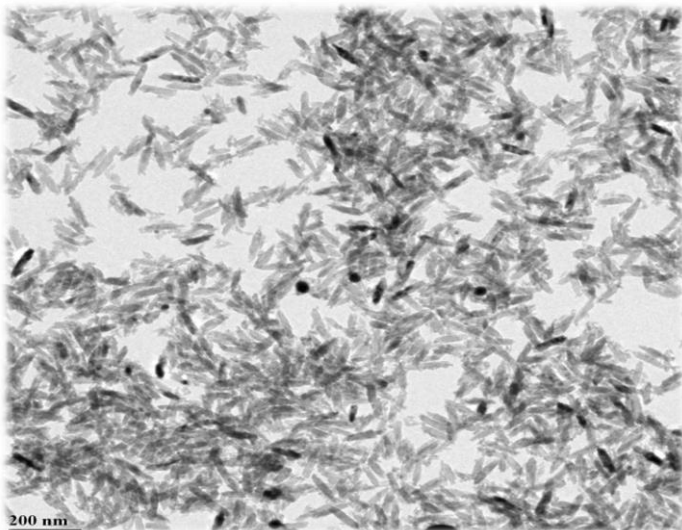
Au Metal Doped Nano Strands



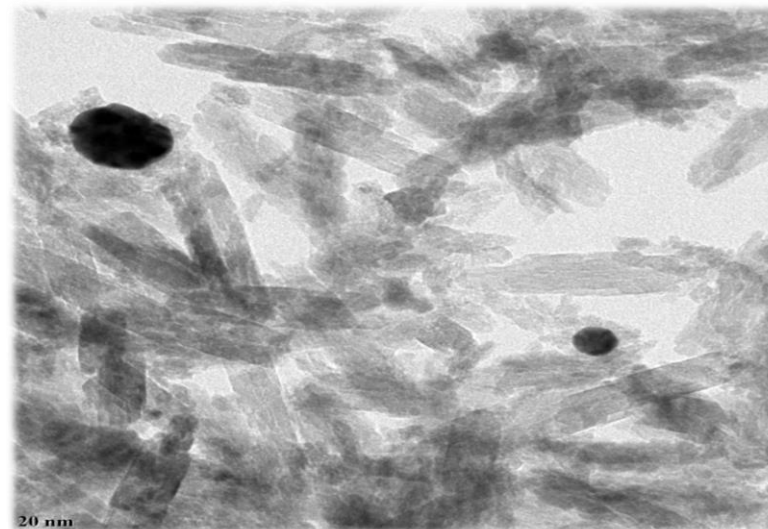
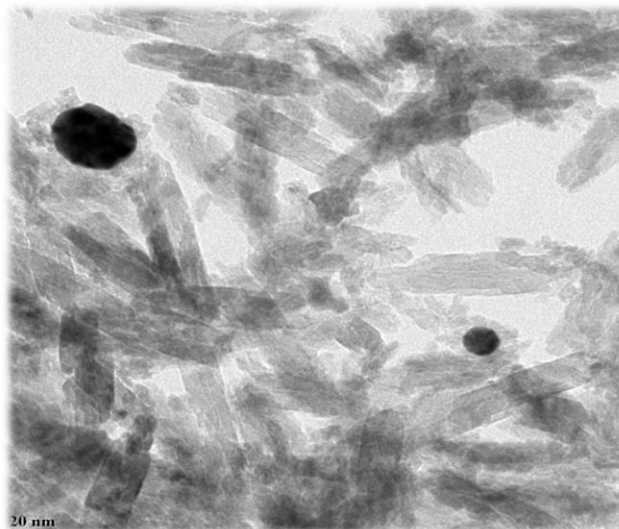
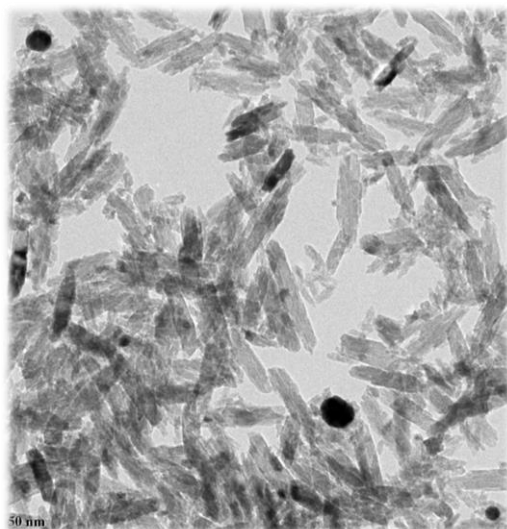
Pt Doped Titanium Nano Strands

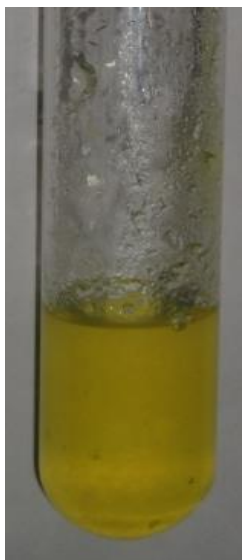


Titanium Oxide Nano Strands



Pt/TiO₂

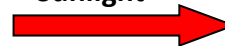




+



Sunlight



Adsorbent

**Colored
effluent**

**Color
removal**

**Color decomposition
& gel regeneration**



TiO₂ Nano Strand preparation scale up



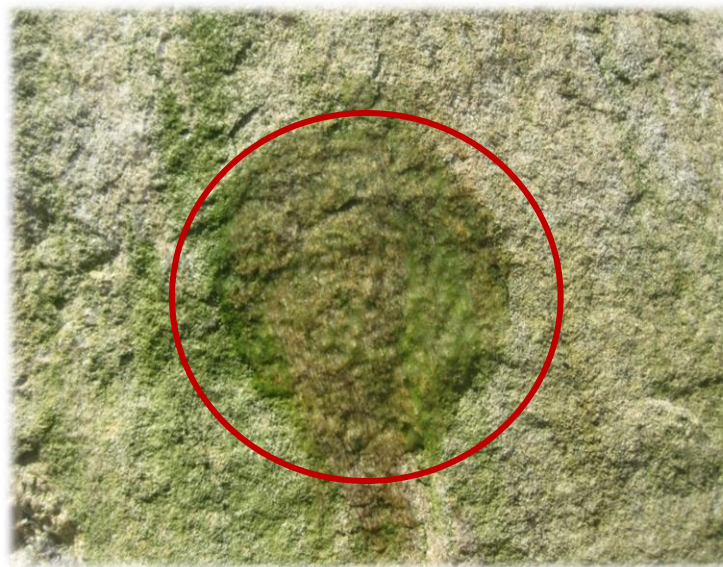
"10th GRIHA SUMMIT"



TiO₂ Nano Strand Coating (TITANCAT)



Mold Formation On Natural Rock



Garden Rock After TiO_2 Coating

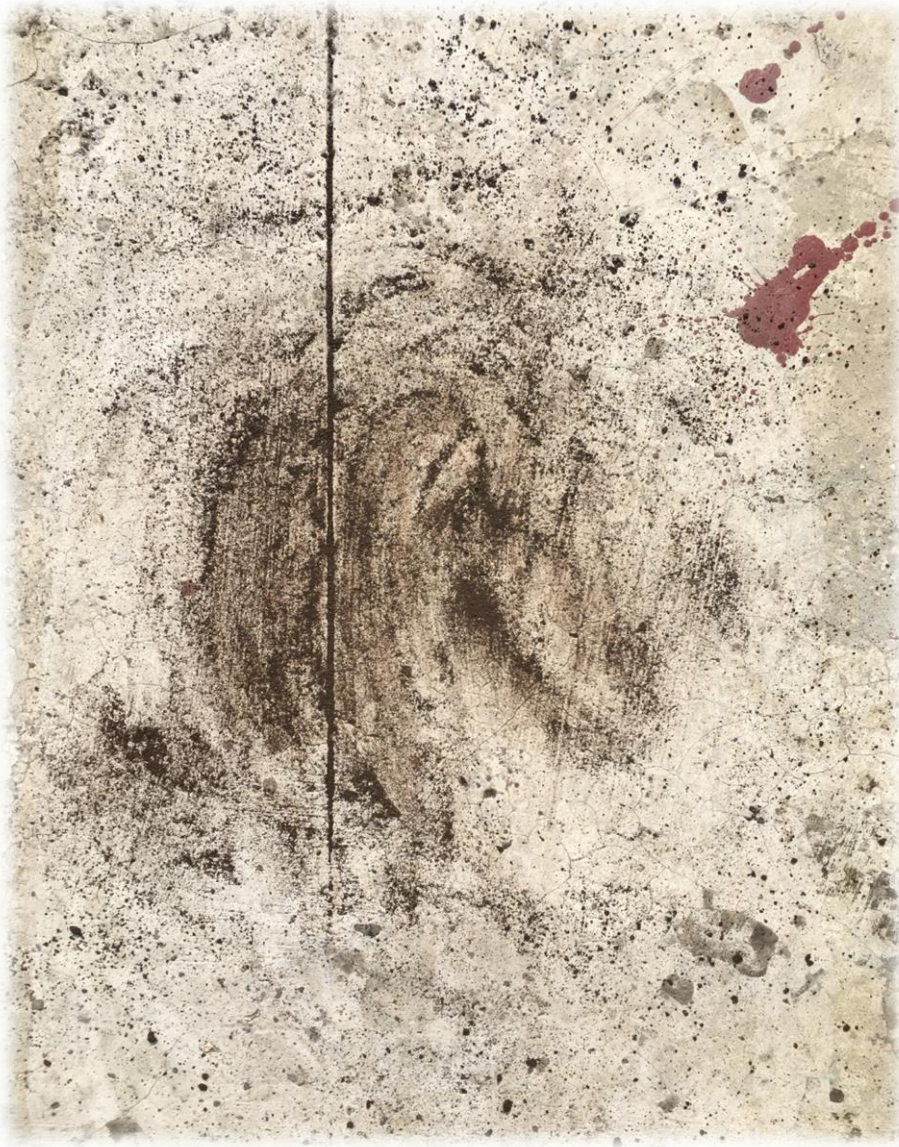


Anti-mold Application



Hydrophobic





Self Cleaning Mechanism



Self Cleaning Mechanism



Self Cleaning





Used Engine Oil Degradation



Oil Stain Degradation On Coated Surface



Photocatalytic degradation of atmospheric fine particulate matter (PM_{2.5}) collected on TiO₂ supporting quartz fibre filter

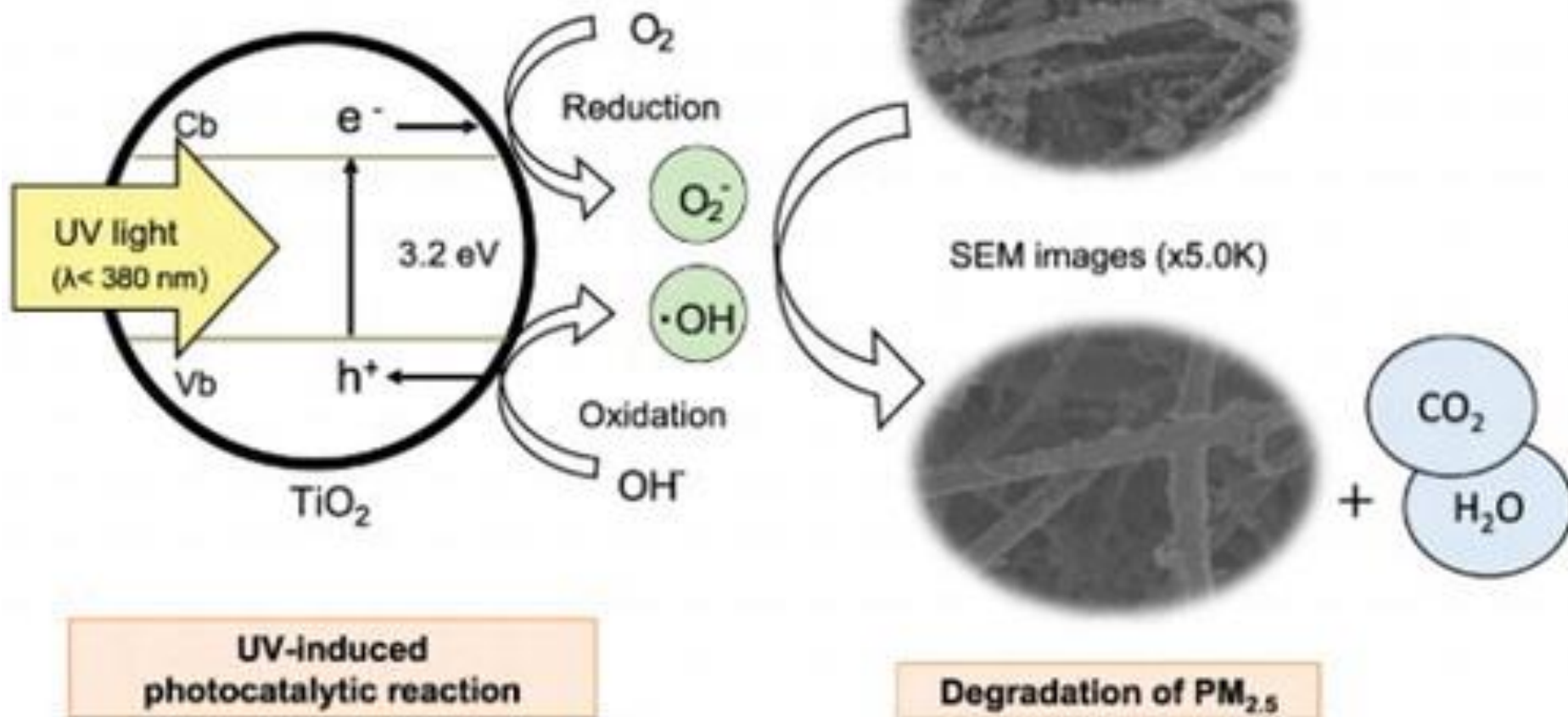
[Kazuhiro Misawa](#), [Yoshika Sekine](#), [Yuki Kusukubo](#) & [Koki Sohara](#)

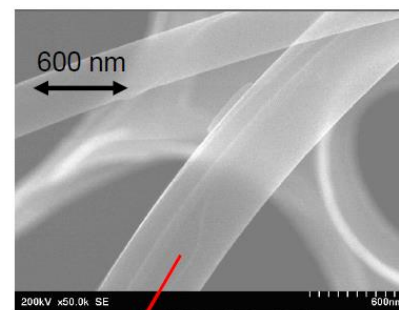
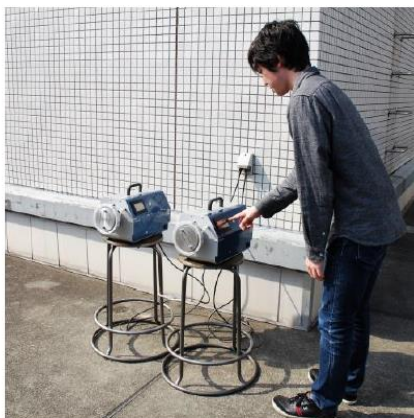
Received 10 Apr 2018, Accepted 25 Sep 2018, Accepted author version posted online: 01 Oct 2018, Published online: 09 Oct 2018

ABSTRACT

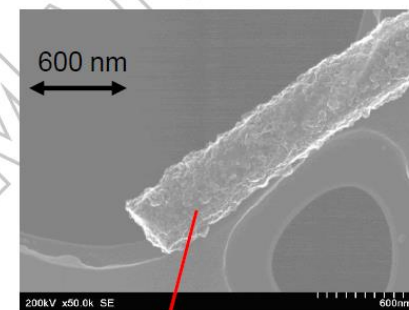
Carbonaceous constituents in fine particulate matter (PM_{2.5}) are often associated with adverse health effects in humans. Although air filtration technology is widely used for preventing exposure to PM_{2.5}, the trapped PM_{2.5} still has hazardous property if not treated subsequently. Thus, this study aimed to realise detoxification of PM_{2.5} with a photocatalytic decomposition of carbonaceous compounds in PM_{2.5} samples collected on a quartz fibre filter coated with titanium dioxide (TiO₂). The mass of PM_{2.5} gradually decreased with time during the UV irradiation with a significant release of carbon dioxide (CO₂) as a product. The analysis of organic carbon (OC) and elemental carbon (EC) using a thermal/optical carbon analyser following the IMPROVE protocol showed that carbonaceous constituents such as OC1, OC2, OC3, OC4, and EC1 fractions were successfully decomposed by UV-irradiated TiO₂, whereas EC2 and EC4 fractions were inert to the photocatalysis. However, a majority of the carbon content, approximately 92% of the total carbon, was reduced by the proposed method. This shows that the photon-induced TiO₂ potentially reduces the hazardous effects of PM_{2.5}.







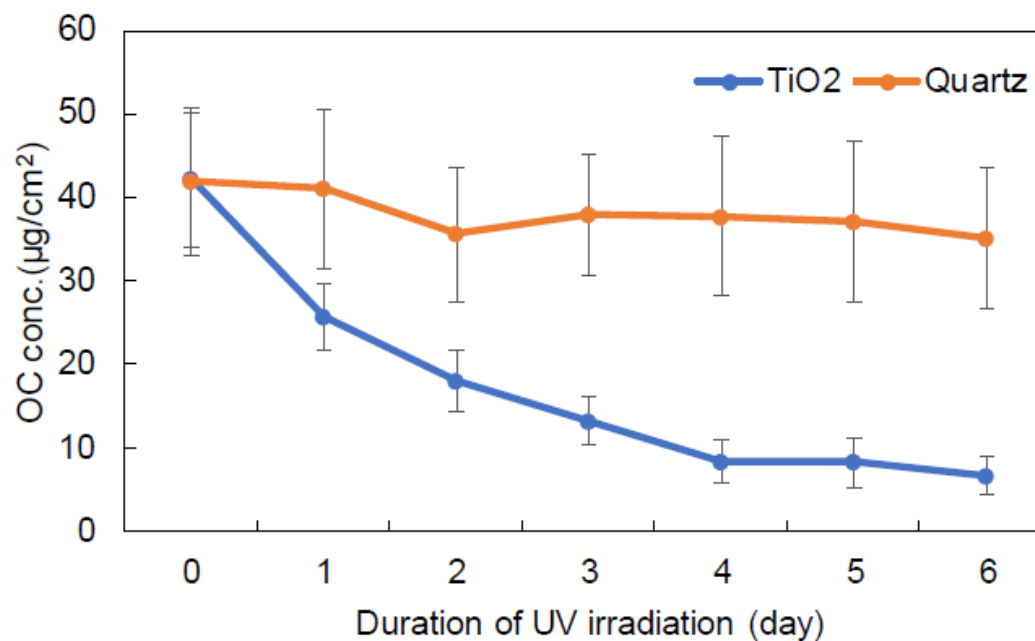
quartz fibre



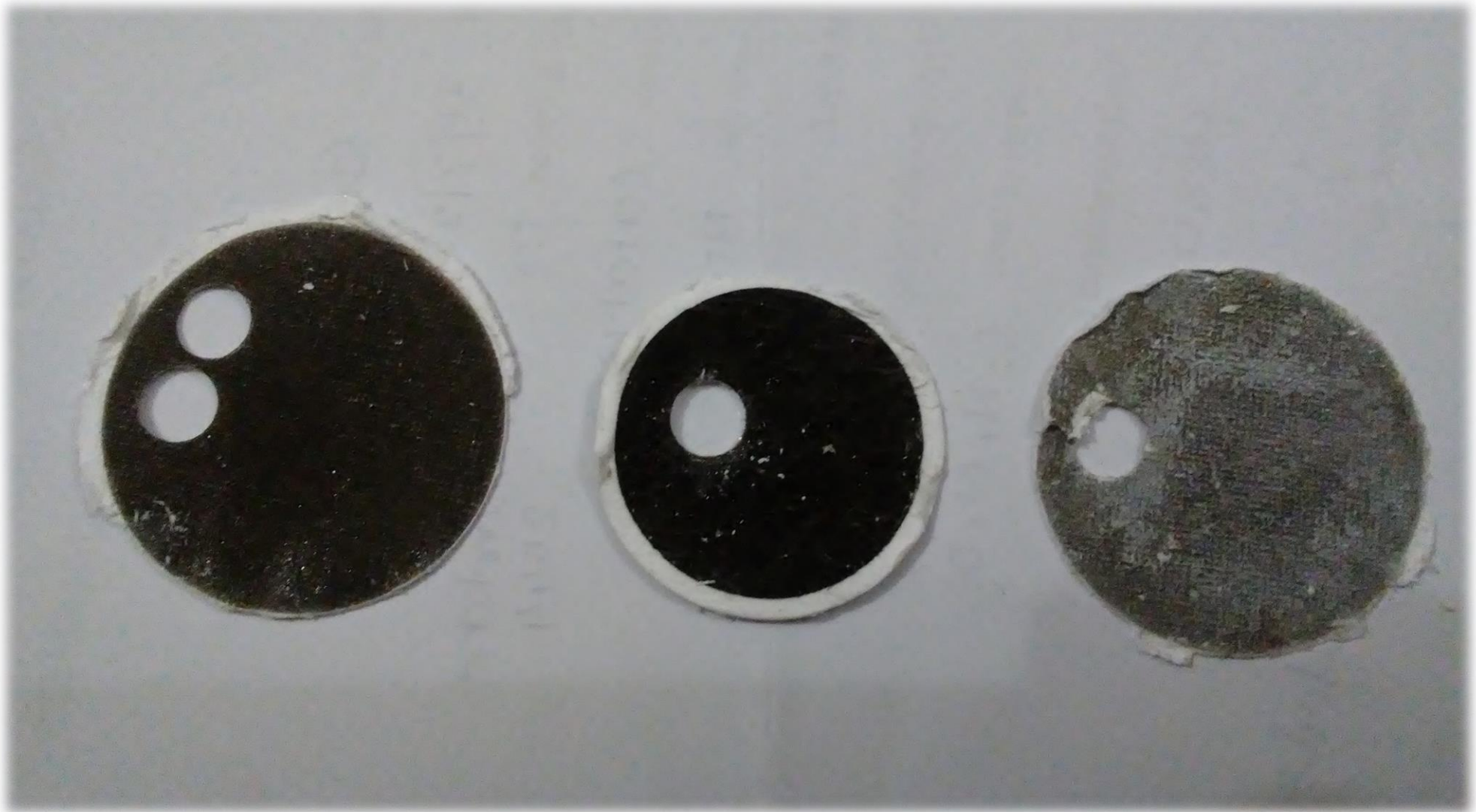
TiO₂-coated quartz fibre

Figure 2. SEM images of the quartz fibre filter before and after depositing TiO₂.

Figure 1. High-volume air samplers and typical PM_{2.5} samples collected on TiO₂ filter.



Our Results of pm2.5



TEST REPORTS



सीएसआईआर - राष्ट्रीय रासायनिक प्रयोगशाला

(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद)

डॉ. होमी भाभा मार्ग, पुणे - 411 008, भारत



CSIR - NATIONAL CHEMICAL LABORATORY

(Council of Scientific & Industrial Research)

Dr. Homi Bhabha Road, Pune - 411 008, India



Dr. Shubhangi B. Umbarkar

Date: 22nd June 2018

Sr. Scientist, Catalysis Division (Environmental Catalysis Group)



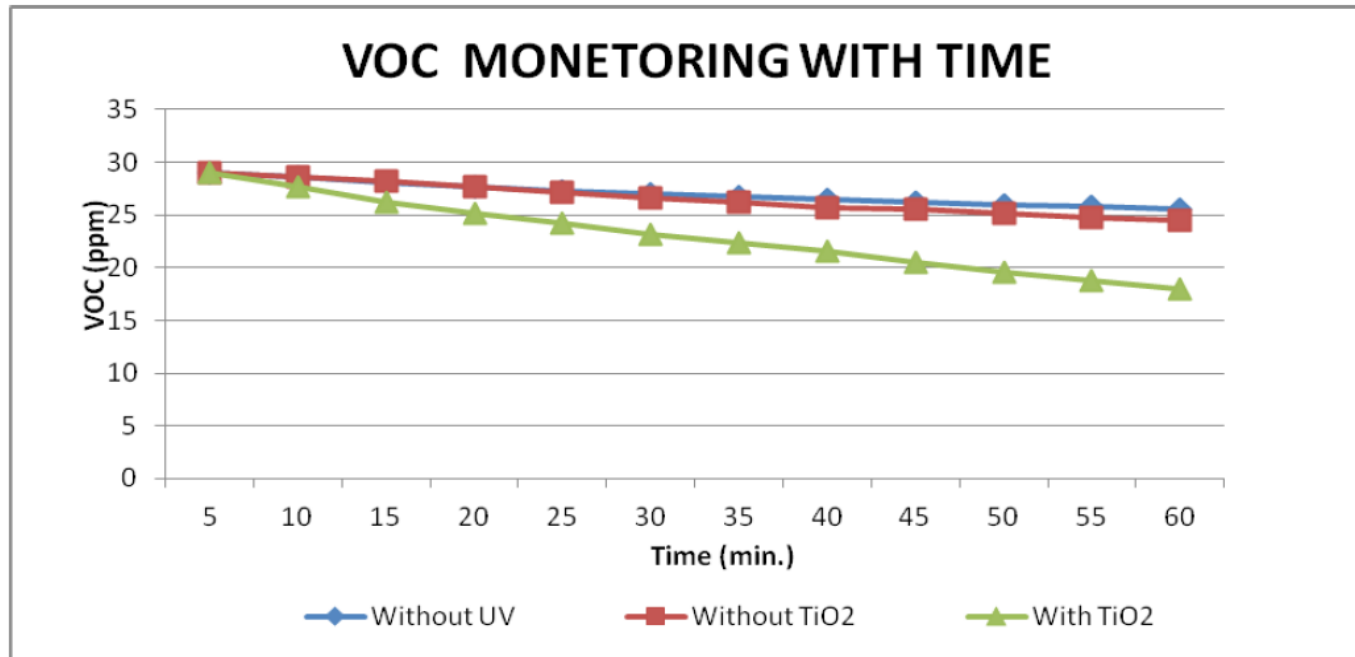
Test composition:

1. CO 1200 ppm + C₃H₆ 1200 ppm + 40% O₂ + 40% CO₂. Sunlight exposure: 5 h
2. NO 936 ppm + 11% O₂ Sunlight exposure: 5 h
3. Toluene 2000 ppm (VOC)

	CO	C ₃ H ₆	NO	Toluene
CONVERSION	98%	100%	100%	100%
DEGRADATION EFFICIENCY	3840 μg/m ² /h	5700 μg/m ² /h	3100 μg/m ² /h	23000 μg/m ² /h



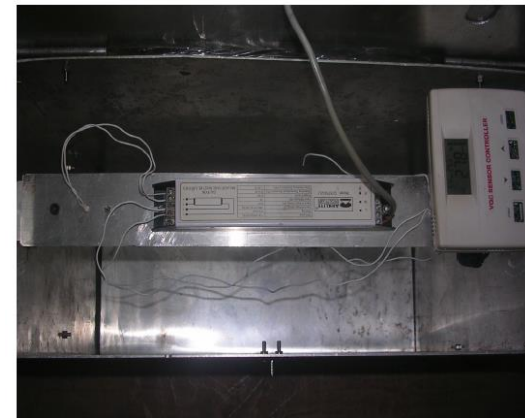
Private Industry Air Purifier



(a) Front View of Box



(b) View Port for taking readings



(c) Inside View of the Box displaying the position of lamp, ballast & VOC sensor controller



Government of India
Ministry of Commerce & Industry
Department of Industrial Policy & Promotion
Controller General of Patents Design & Trade Marks

Online Filing Of Patents

Welcome DR. NITIN SHUKLA [Sign out](#)



Controller General of Patents, Designs & Trade Marks

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E-mail: mumbai-patent@nic.in
Web Site: www.ipindia.gov.in



सत्यमेव जयते



Docket No 31054

Date/Time 30/08/2017

To
DR. NITIN SHUKLA

User Id: NitinShu

NSA-85, NCL COLONY, NCL

Sr. No.	Ref. No./Application No.	App. Number	Amount Paid	C.B.R. No.	Form Name	Remarks
1	201621029501	E-2/1905/2017/MUM	0		FORM 2	

Total Amount : ₹ 0

Amount in Words: Rupees Only

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“CONCLUSION”

TITANCAT BENEFITS	TITANCAT APPLICATIONS
Air Purification	Residential Building
Smog Eating	Industrial Building
Deoderizing	Any Concrete Surface
Maintains The Aesthetics Of The Building Or Structure	Tunnels
Self Cleaning Property	Most Civil Structures
Super Hydrophilicity	UV Based Air Purifiers
Easy To Apply Coating	*TITANCAT Can Be Applied By Mechanical Spraying / Roller Brush



COST ANALYSIS

COMPANIES	COST
GREEN EARTH NANO SCIENCE, CANADA	1750 US \$ for 10ltrs (INR Rs.1,22,500)
PURETI, USA	Rs. 30,000 for 1 gallon
KON CORPORATION, JAPAN	Rs. 10,000 for 1 ltr

Our Technology : Affordable





PROJECT: Los Angeles Community College District - Build Green



PROJECT SUMMARY: LACCD-BUILD Green is a \$5.7 billion green building project that spans over 400 buildings on 9 separate college campuses in Los Angeles. The goal of LACCD-BUILD Green is to modernizing its colleges while protecting the environment and improving the quality of life for its 250,000 students, teachers and affiliates.

COST: \$0.70 per sq. ft. fully applied.

“We went with an innovative titanium dioxide coating that wards off dirt and pollution, removing organic pollutants from the air and reversing the effects of greenhouse gases. It proved a major success and will cut our maintenance costs for years to come.” — Executive Director, Larry Eisenberg. LACCD-BUILD Green

FUTURE PLANS

- Getting affiliation from **GRIHA** and other green building organization.
- Development of Air Purifier Devices for Domestic, Industrial & Public Places.
- We are proposing this technology at an affordable cost.





Thanks

For further queries please feel free to contact me on:

Email: mohanenvipure@gmail.com

Phone: +91-9422339251